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LMSC-448412
21 July 1961
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25 Sheets

NASA

ENGINEERING ANALYSIS REPORT
SUBSYSTEM C&C FOR VEHICLE 6001

TITLE UNCLASSIFIED

Contract AF 04(647)-592

Prepared under authority of AFBM Exhibit 58-1,
Paragraph 3.15

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FOREWORD

This report was produced by Lockheed Missiles and Space Company for the Air Force in accordance with Contract AF 04(647)-592. It describes the Communications and Control Subsystem for NASA Vehicle 6001.

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SECTION 1 INTRODUCTION

The Communications and Control (C&C) subsystem for Vehicle 6001 performs the following functions:

- a. Telemetry of Agena vehicle functions and payload telemeter base band from launch until the end of the Agena second-burn period
- b. Radar tracking using a C-band beacon
- c. Transmission of payload telemetry signals before payload telemeter antennas are exposed by ejection of the nose fairing

No command control or programming of events is required by the C&C subsystem; all equipment is turned on before the vehicle launch and it remains on for the life of the Agena B batteries (about 212 minutes).

Major components of the C&C subsystem are:

- a. C-band radar beacon
- b. VHF FM-FM telemeter
- c. Parasitic antennas for transmission of payload signals
- d. C-band beacon antenna system
- e. VHF antenna system

A block diagram of the system is shown in Figure 1-1.

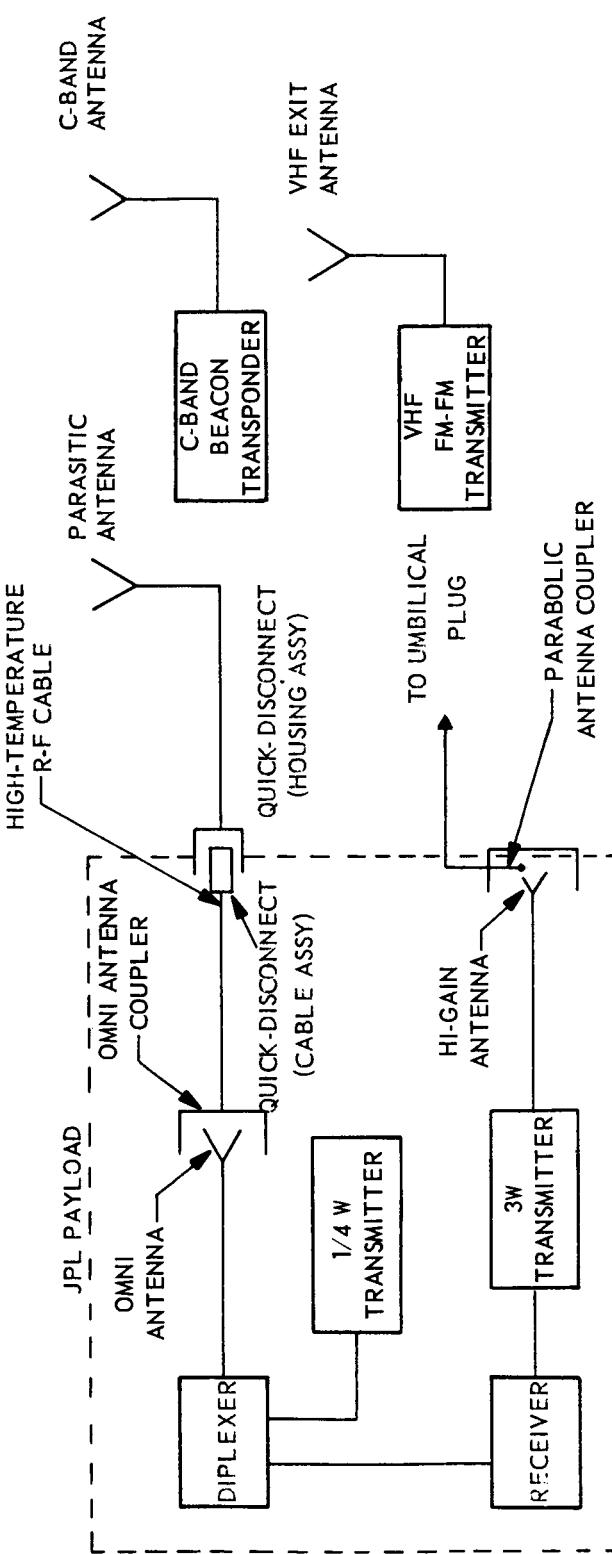


Figure 1-1 Block Diagram of Communications and Control Subsystem

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SECTION 2

C-BAND RADAR BEACON

2.1 DESCRIPTION

The radar beacon (Fig. 2-1) is an ACF Electronics, type 149-C10. It functions as a transponder in response to a coded pulse from a C-band tracking radar.

The radar beacon is a single unit containing a power supply, superheterodyne receiver, pulse decoder, and transmitter. In addition, outputs are provided for operating a command-decoder unit, and for monitoring the beacon transmitter and receiver performance and the temperature of the beacon. All circuits are transistorized except the local oscillator and transmitter. The beacon is enclosed in a pressure-sealed case which measures about 8 1/2 inches by 4 1/2 inches excluding mounting lugs.

2.2 ELECTRICAL CHARACTERISTICS

Frequency range	5400 to 5900 megacycles/sec
Stability	± 4 megacycles/sec
I-F frequency	50 megacycles/sec
Sensitivity	-65 dbm minimum
Bandwidth at -3 db	8 ± 2 megacycles/sec
Output	Single pulse, 0.7 ± 0.2 microsecond
Pulse rate	150 to 2000 pps
Decoder	Two-pulse, adjustable
Output power	800 watts, minimum
Supply voltage	24.0v dc nominal
Supply operating range	23.0 - 30.0v dc
Supply current	1.1 amperes, nominal
Additional outputs	Pulse outputs for command unit, 25v dc for command unit, beacon temperature monitor (v dc), receiver monitor (v dc) and transmitter monitor (v dc)

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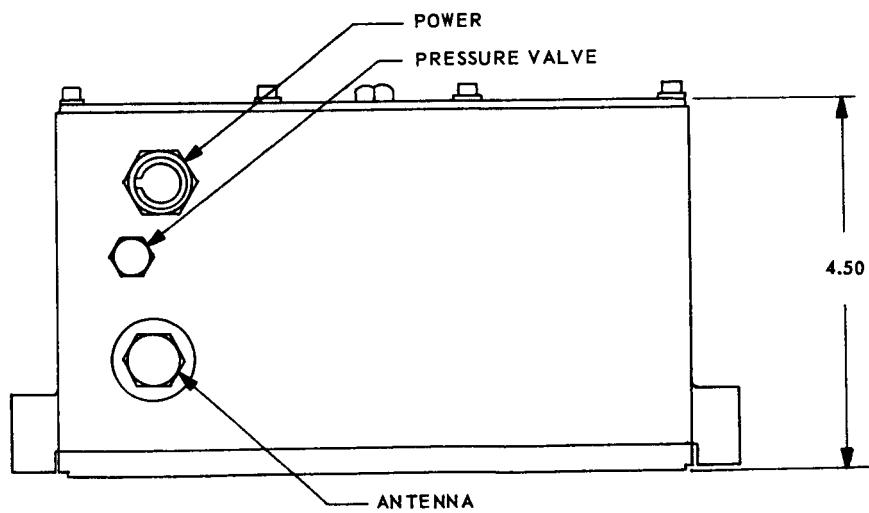
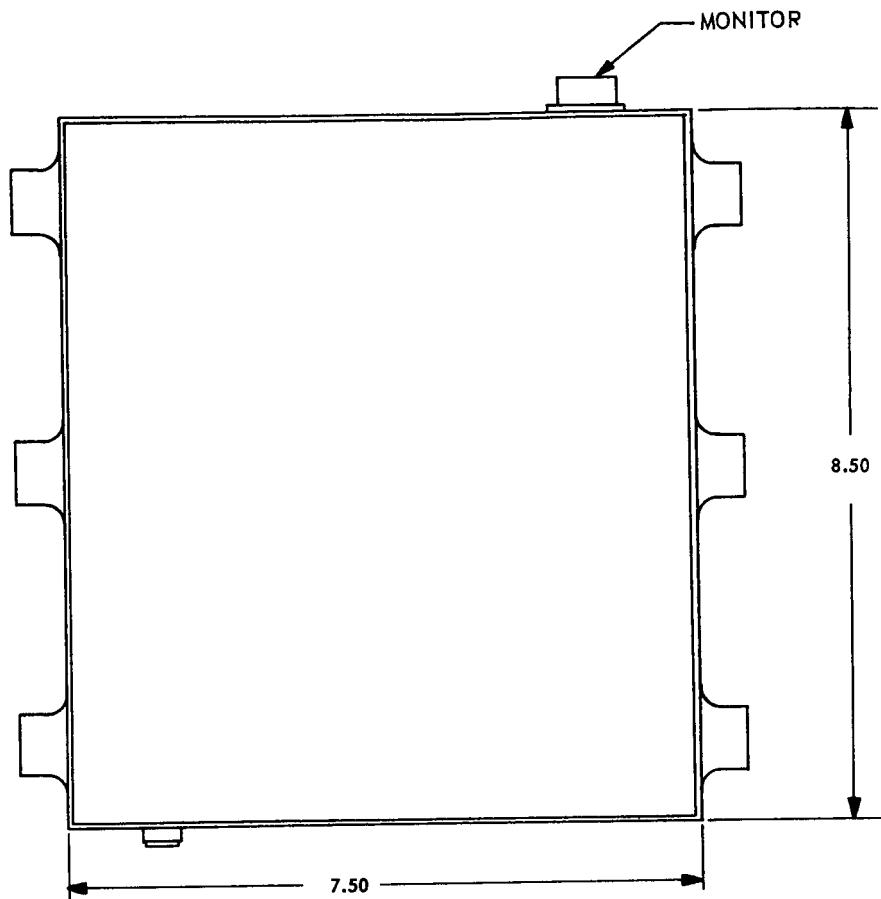


Figure 2-1 C-Band Radar Beacon

2-2

2.3 PHYSICAL CHARACTERISTICS

Length (overall)	8.62 inches
Width	8.50 inches
Height (overall)	4.77 inches
Weight	12 lb nominal
Temperature range	-30° F to +165° F
Vibration limits	3g, 5 to 100 cps 5g, 100 to 500 cps 10g, 500 to 2000 cps

2.4 CIRCUIT OPERATION (Fig. 2-2)

Operating power for the radar beacon is taken from the +28-vdc unregulated power supply. The power is fed through a line filter and d-c regulator to a transistorized power multivibrator. The square-wave output of the multivibrator is applied to the primary of the power transformer.

Four secondary windings on the power transformer supply the required voltages for operating the beacon. The output of each winding is rectified by either a full-wave circuit or a bridge-rectifier circuit.

Interrogation signals from the antenna are fed through the duplexer to the 3-section preselector where the desired receiver frequency is selected. Then these signals are mixed with the signal from the local oscillator, and the difference frequency of 50 Mc is fed through the I-F amplifier. The output of the I-F amplifier is detected and the pulse code is fed to the pulse amplifier and decoder.

The decoder circuit detects a specific two-pulse code. The time spacing between the pulses is compared with the pulses developed by multivibrators in the decoder circuit. If the code-pulse timing is correct, an output pulse is developed by the decoder. If the code pulse timing is incorrect, no output is produced.

The output of the decoder is fed to the modulation-driver circuit where it is amplified by the driver and then applied as a trigger to the modulator circuit.

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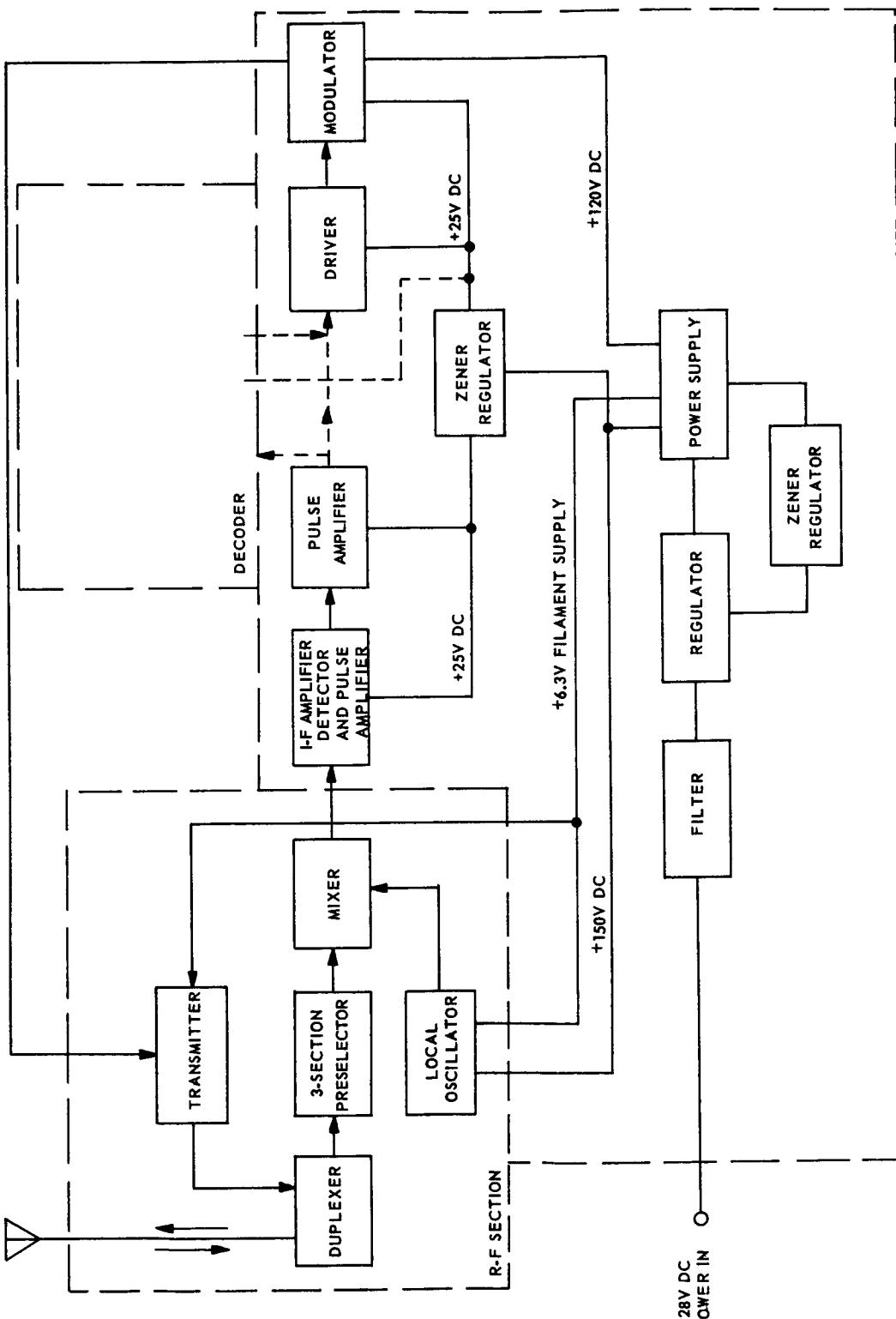


Figure 2-2 Block Diagram of C-Band Radar Beacon

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A 0.7-microsecond pulse of high voltage is applied by the modulator circuit to the transmitter tube each time the modulator circuit is triggered. The transmitter tube produces bursts of R-F energy while the pulses are being applied. The high power R-F energy is fed through the duplexer to the antenna and the action of the duplexer prevents this energy from reaching the receiver stages.

2.5 LINK CALCULATIONS

Radar - AN/FPS-16
Transponder - ACF Type 149-C10

	Ground-to-Air (dbm)	Air-to-Ground (dbm)
Transmitter power	84	59
Transmitter line loss	-2	-2
Transmitter antenna gain	44.5	0
Free space loss, 830 nm (horizon at 100 nm altitude)	-172	-172
Receiver antenna gain	0	44.5
Receiver line loss	-2	-2
Subtotal	-47.5	-72.5
Receiver sensitivity	-65	-95
Signal excess	+17.5 db	+22.5 db

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SECTION 3

VHF FM-FM TELEMETER

3.1 DESCRIPTION

The Agena-B telemeter (Fig. 3-1) is the LMSC unitized FM-FM type I which is flight-qualified and has been used successfully on many Agena vehicles.

The telemeter is modular in construction and it includes:

- a. Transmitter
- b. R-F amplifier
- c. Power supply
- d. Two commutator signal conditions
- e. Commutator, 60 pt., 5 rps, 2-pole (2 units)
- f. Switching unit
- g. Junction box and tray assembly containing VCO's, voltage regulator, modulation amplifier, base-band coupler, turbine speed coupler, programming boards and plugs, VCO input switching relays, in-flight calibration relays and calibration voltage regulator.

At time of assembly, jumpers are added to terminal boards where necessary to characterize the system dictated by the vehicle-instrumentation schedule.

3.2 CIRCUIT OPERATION (Figs. 3-2 and 3-3)

Nine voltage-controlled subcarrier oscillators (VCO) and IRIG channels 10 through 18 of the inter-range instrumentation group (IRIG) are used for frequency-division multiplexing of 0-to-5-volt data inputs. Inputs for channels 15, 16, 17, and 18 are commutated using two 60-segment, 2-pole, 5-rps motor-driven sampling switches. The LMSC 100% duty-cycle format is used instead of the IRIG format since it has double the number of data

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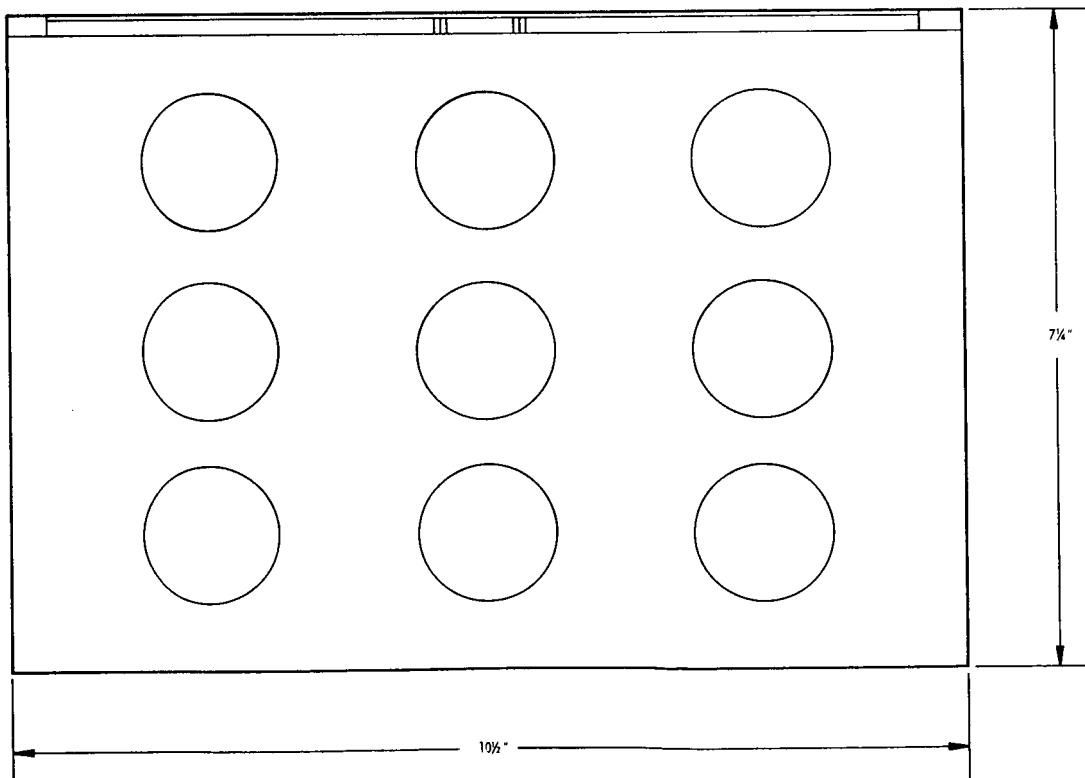
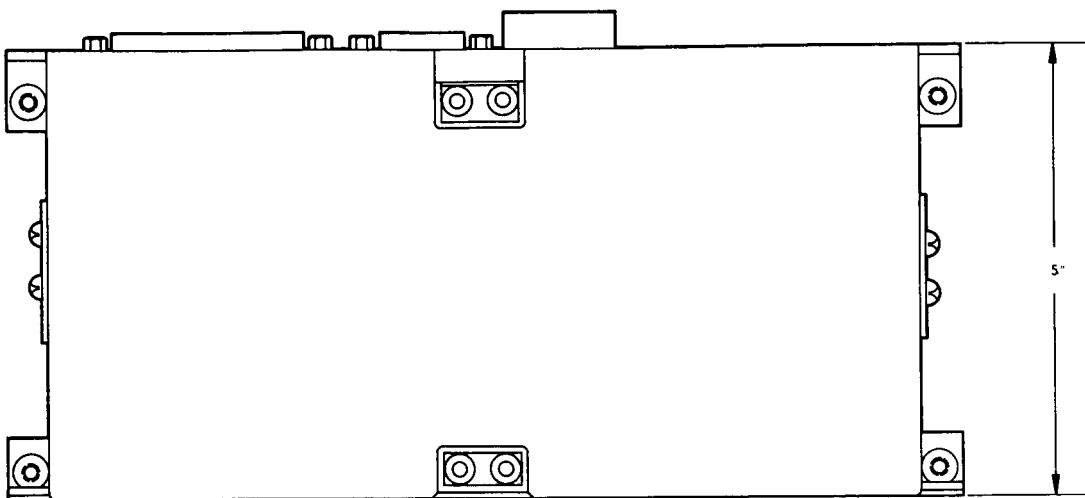


Figure 3-1 Unitized FM-FM Telemeter System

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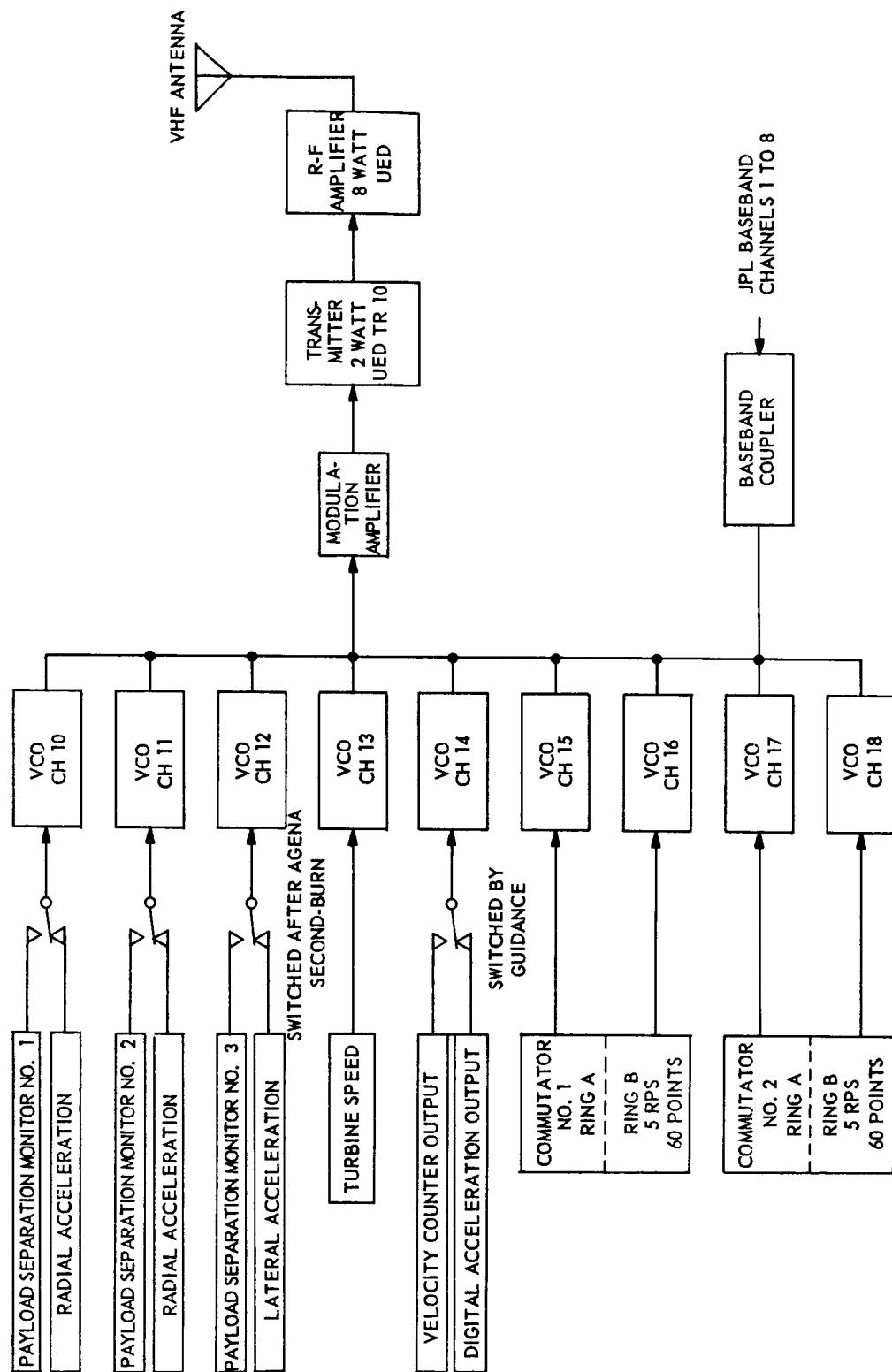


Figure 3-2 Block Diagram of VHF FM-FM Telemeter Parasitic Antenna

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points and better resolution, because data levels are 100% subcarrier bandwidth rather than 80% as in the IRIG system. The Appendix (Instrumentation Schedule) shows the data points, sync points and calibration points of the commutated channels.

Continuous channels 10, 11, and 12 are switched from acceleration data to payload-separation data at the end of Agena second-burn period. Channel 14 is switched from Subsystem-D (SS/D) accelerometer output to velocity-counter output for 10 seconds at the end of Agena first-burn period and again for 150 seconds at the end of the second-burn period. The source of switching signals is the SS/D timer. Latching relays in the telemeter are used for the switching of a number of data inputs.

Three-point (0, 2.5 and 5v dc) calibration of the oscillators before launch and in flight can be accomplished. In-flight calibration of the telemeter, which is initiated by the SS/D timer occurs after Agena second burn. Calibration-voltage source is a two-section Zener regulator. An identical regulator is used in the commutator signal conditioners for calibration voltages and sync voltages on commutated channels. These channels are calibrated on every revolution of the commutator.

Channels 1 to 8 of the IRIG in the payload telemeter are coupled, through the base-band coupler, to the Agena telemeter. This unit is a transistorized amplifier followed by a low-pass filter.

The composite signal from the subcarrier oscillators and the payload telemeter base band is amplified to the level required for full deviation of the transmitter by the modulation amplifier.

The power source for the telemeter is the vehicle's 115-v, 2000-cps inverter. The telemeter power supply is a transformer-rectifier-filter type. Output voltages are 200v dc for the transmitter and R-F amplifier plates, 6.5v dc for the transmitter and R-F amplifier heaters, and +30v dc and -30v dc for the voltage regulator which supplies the subcarrier oscillators with +20v dc and -20v dc.

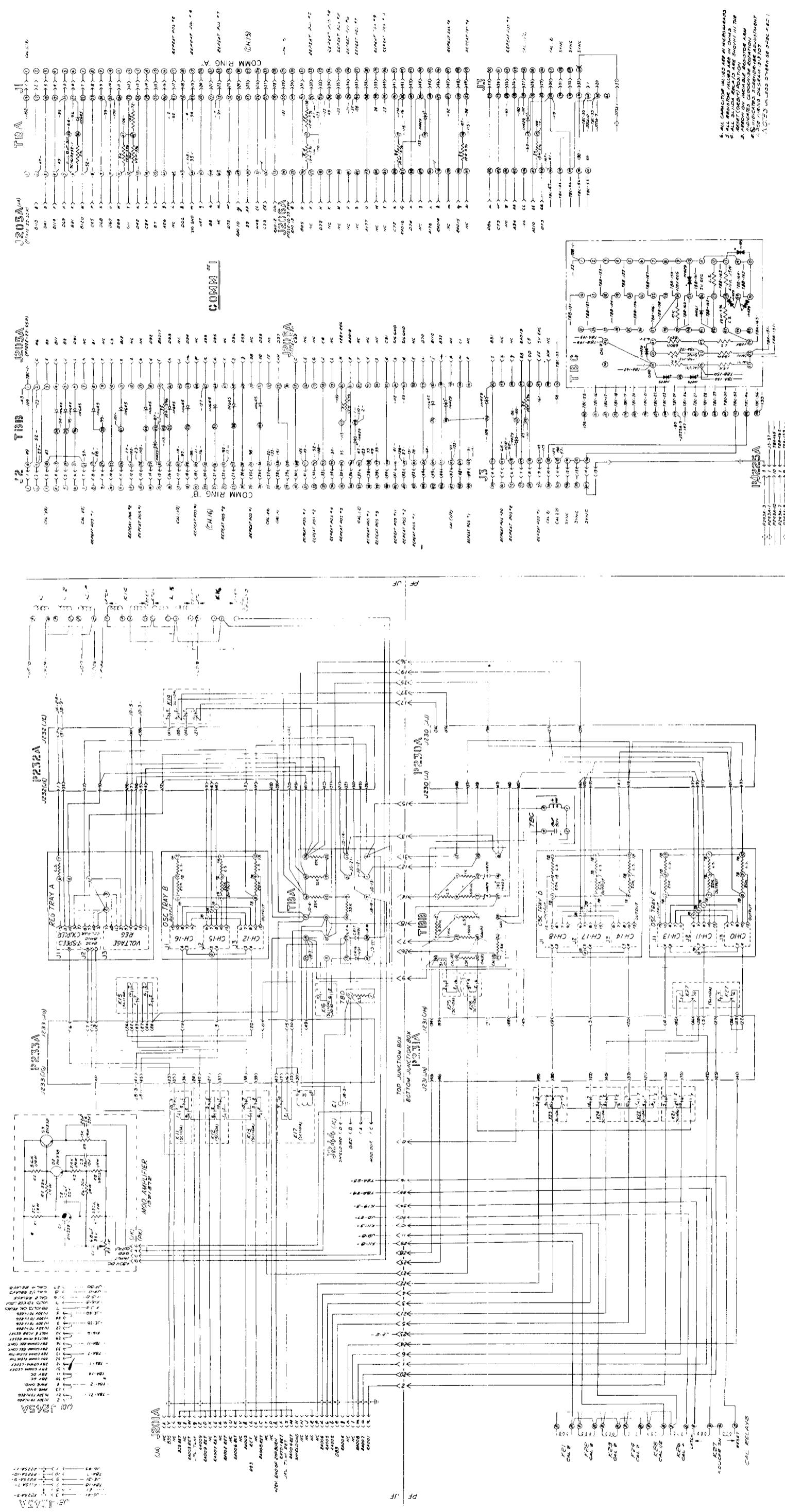


Figure 3-3 Schematic of VHF FM-FM Telemeter

3.3 COMPONENT SPECIFICATIONS

Electrical specifications of major components of the telemeter are summarized in the following paragraphs. Complete specifications of components are given in the referenced LMSC specifications. All components have been qualification-tested in accordance with LMSC Specification 6117B, "General Environmental Specification."

3.3.1 Voltage Controlled Oscillators

Type: United Electro Dynamics Corporation (UED) TS0200B

LMSD specification: 1072208C

Input power: +28v dc $\pm 0.5\%$, 14.5 ma
-28v dc $\pm 0.5\%$, 8 ma

Output: 4.0 volts rms at center frequency, down not more than 2.5 db across the band

Oscillator frequency and tolerance limits:

Lower band edge - Inside 2% $\pm 2\%$
Center frequency - IRIG $+2\%$, -1%
Upper band edge - Inside 1% $\pm 1\%$

3.3.2 Modulation Amplifier

LMSC drawing number: 1321487

LMSC specification: 1410234

Input power: 22 to 29v dc at 2.5 to 4.5 ma

Input signal range: 0 to 600 mv

Gain: Adjustable from zero to greater than 80 into a 15K ohm load

Input impedance: 1000 ohms $\pm 10\%$

Frequency response: ± 1 db from 100 to 100,000 cps

Output impedance: Between 100 and 100,000 cps - 2000 ohm maximum

Distortion: Less than 0.5% at a gain of 70 from 100 to 100,000 cps

3.3.3 Base-Band Coupler

LMSC drawing number: 1320855

LMSC specification: 1068097

Input power: 22 to 29v dc at 5 ma $\pm 10\%$

Input signal range: 1 to 3 volts rms input for 4 volts rms output

Input impedance: 10K ohms $\pm 10\%$

Frequency response: Flat ± 1 db from 100 to 4000 cps, down
14 db or more at 10,000 cps

Distortion: Less than 0.5%

3.3.4 Commutator-Motor Driven Sampling Switch

LMSC specification: 1067244B

Radio noise interference: MIL-I-6181

Pole phasing: Contacts on all poles are in phase electrically
within one degree of wiper rotation.

Duty cycle: The shorting time is 20% or less and the nonshorting
time is 80% or more.

Contact resistance: Less than one ohm

Service-free life: 200 hours minimum

Sampling rate: 5 rps $\pm 8\%$ at rated motor voltage

Motor voltage and current: 27.5v dc nominal and current does
not exceed 300 ma

Motor noise: The motor does not contribute current ripple to
the power supply that is more than 10% peak-to-peak
of the average motor current.

3.3.5 Transmitter

Type - UED TR10

LMSC specification: 1411045

Frequency: 244.3 megacycles

Input power: 200v dc $\pm 5\%$ at 120 ma max
6.3v dc $\pm 5\%$ at 850 ma max

Input impedance: 11K ohms $\pm 1K$ ohm shunted by 10 micromicrofarad

Power output: 2.4 watts min into a 50 ohm load

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Frequency response: ± 1.5 db from 5 to 100,000 cps

Modulation linearity: $\pm 1\%$ from best straight line on a plot of input voltage versus output frequency

Modulation distortion: Total modulation harmonic distortion less than one percent at a deviation of ± 40 kc when modulated by a 5-kc signal

Frequency stability: $\pm 0.01\%$, cumulative from all courses

3.3.6 R-F Amplifier

Type - UED Type PA10

LMSC specification: 1068855B

Power input: 200v dc $\pm 5\%$
28v dc $\pm 5\%$

Input impedance: 50 ± 15 ohms

Power output: 8 watts minimum into 50-ohm load with input power not less than 2 watts at nominal plate and heater voltages

3.4 LINK CALCULATIONS

Link calculations for the telemeter are as follows:

Transmitter power (8 W)	+39 dbm
Transmitter line loss	-0.5 db
Transmitter antenna gain	+4 db
Free space loss (830 nm) (horizon at 100 nm altitude)	-144 db
Polarization loss	-3 db
Receiver line loss	-1.5 db
Receiver antenna gain	+27 db
Receiver input	-79
Receiver noise (KTB)	-119 dbm
Receiver noise figure (F)	5 db
F KTB	-114 dbm
Carrier-to-noise at receiver input	+35 db
Required carrier-to-noise ratio	+12 db
Margin	+23 db

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SECTION 4 R-F SYSTEMS

4.1 GENERAL DESCRIPTION

Three distinct R-F systems are used on Vehicle 6001:

- a. Payload monitor and parasitic antenna system which monitors the performance of the payload during the exit phase and before nose-cone separation when the payload becomes independent
- b. C-band beacon antenna system which is used for the exit downrange tracking of the Ranger flight
- c. The VHF telemetry antenna system which radiates Agena and Ranger telemetry during the exit phase of the flight.

4.2 PAYLOAD MONITOR AND PARASITIC ANTENNA SYSTEM

4.2.1 General Information

Antenna type: Cavity backed 3-slot array

Frequency range of operations (transponder):

Transmitter = 960 Mc
Receiver = 890 Mc

Coverage required: T + 0 sec to T + 283 sec

Frequency used for pattern: Measurements = 3700 Mc

Model scale: 1/4 scale

4.2.2 Transmitter Information

Total power level at transmitter antenna system:

f = 960 Mc	Average level = +5 dbm
f = 890 Mc	Average level not known (no interrogation function is required during launch)

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4.2.3 Receiver Information

Minimum power level required at receiver antenna system:

$f = 960$ Mc (ground sta) Power level not known
 $f = 890$ Mc (missile borne) Power level = -139 dbm

4.2.4 Polarization Information

Polarization Vectors:

Linear - $\theta = \text{LMSC Sta } 275.00$, $\phi = 180^\circ$ (LMSC station number is given instead of angle θ because the c.g. is not known)

4.2.5 Parabolic Antenna Coupler

This probe-type coupler supplies an output from the payload 3-watt transmitter, through the payload parabolic antenna, to the umbilical plug in the forward equipment section of Agena B.

4.2.6 Omnidirectional Antenna Coupler

This flat plate-type coupler is located 1-3/8 inches from the payload discone antenna and it samples the output of the payload 1/4-watt transmitter. The sampled signal is transmitted through the coaxial quick-disconnect to the parasitic antenna (Fig. 4-1) located in the forward equipment section of Agena B. The parasitic antenna is a three-element, strip line array backed by a cavity. This system assures the operation of the payload low-power system from launch to separation of the Agena shroud and Agena-B body. Its radiated power pattern (Figs. 4-2 and 4-3) is such that maximum radiation is directed aft.

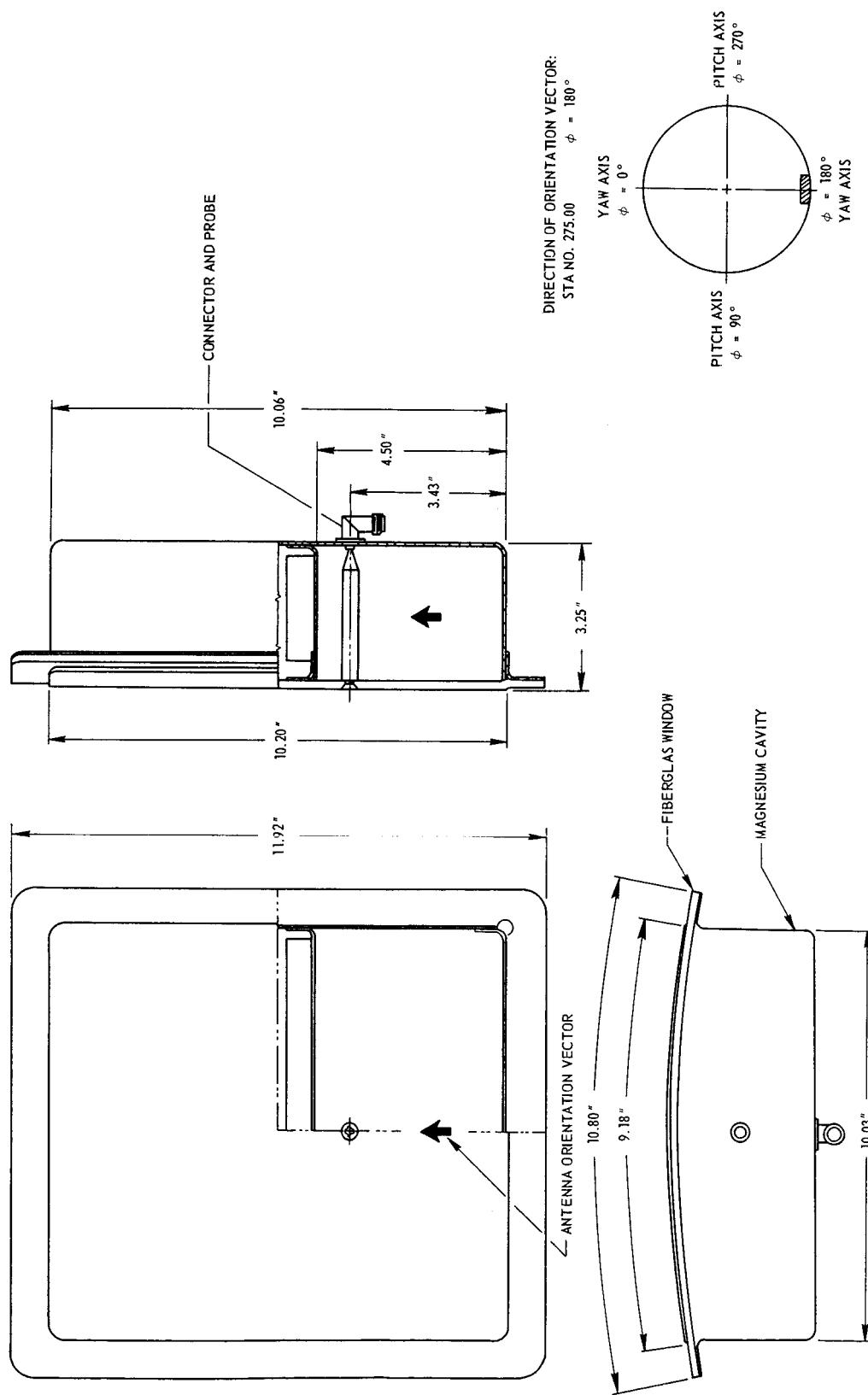
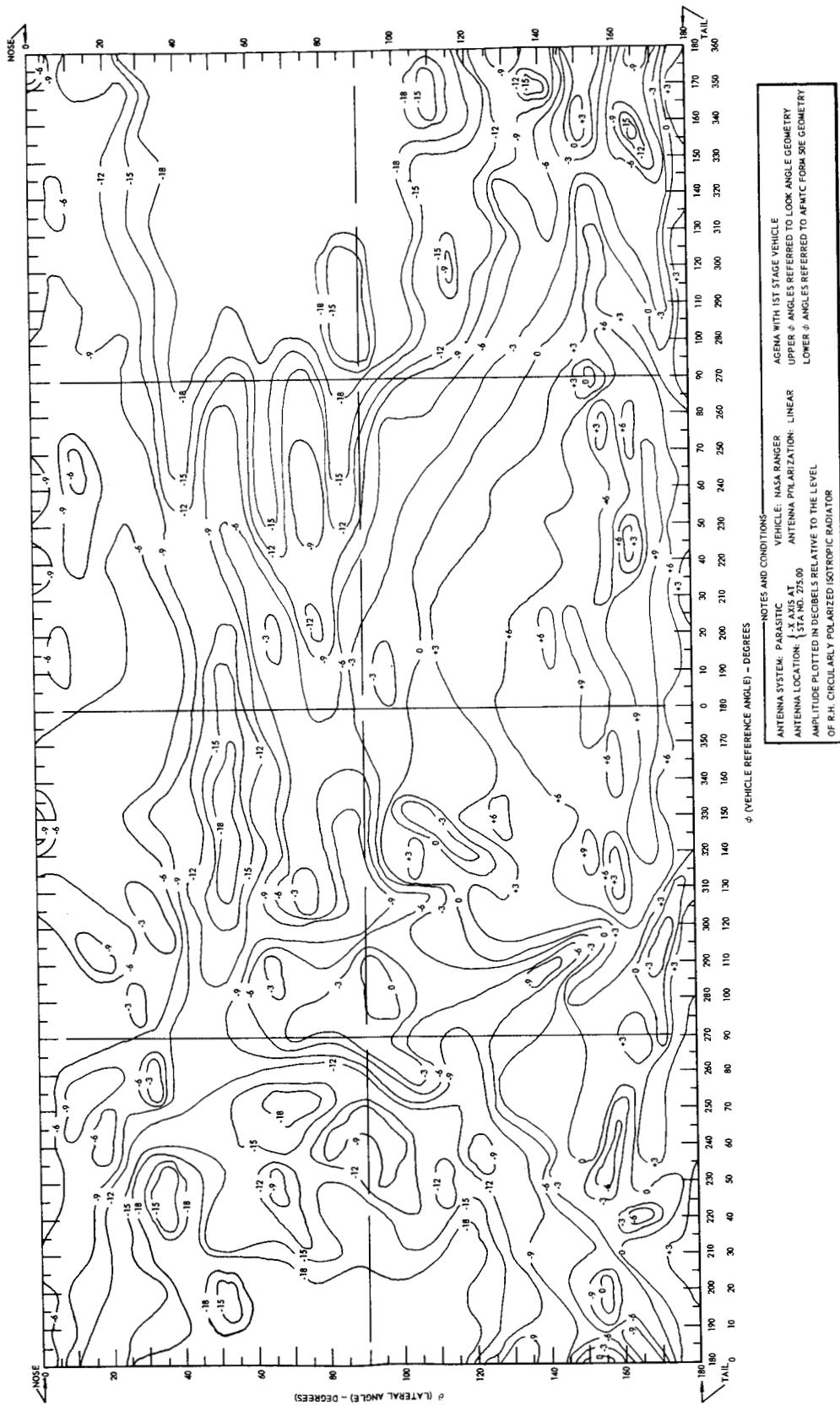


Figure 4-1 Parasitic Antenna



4-4

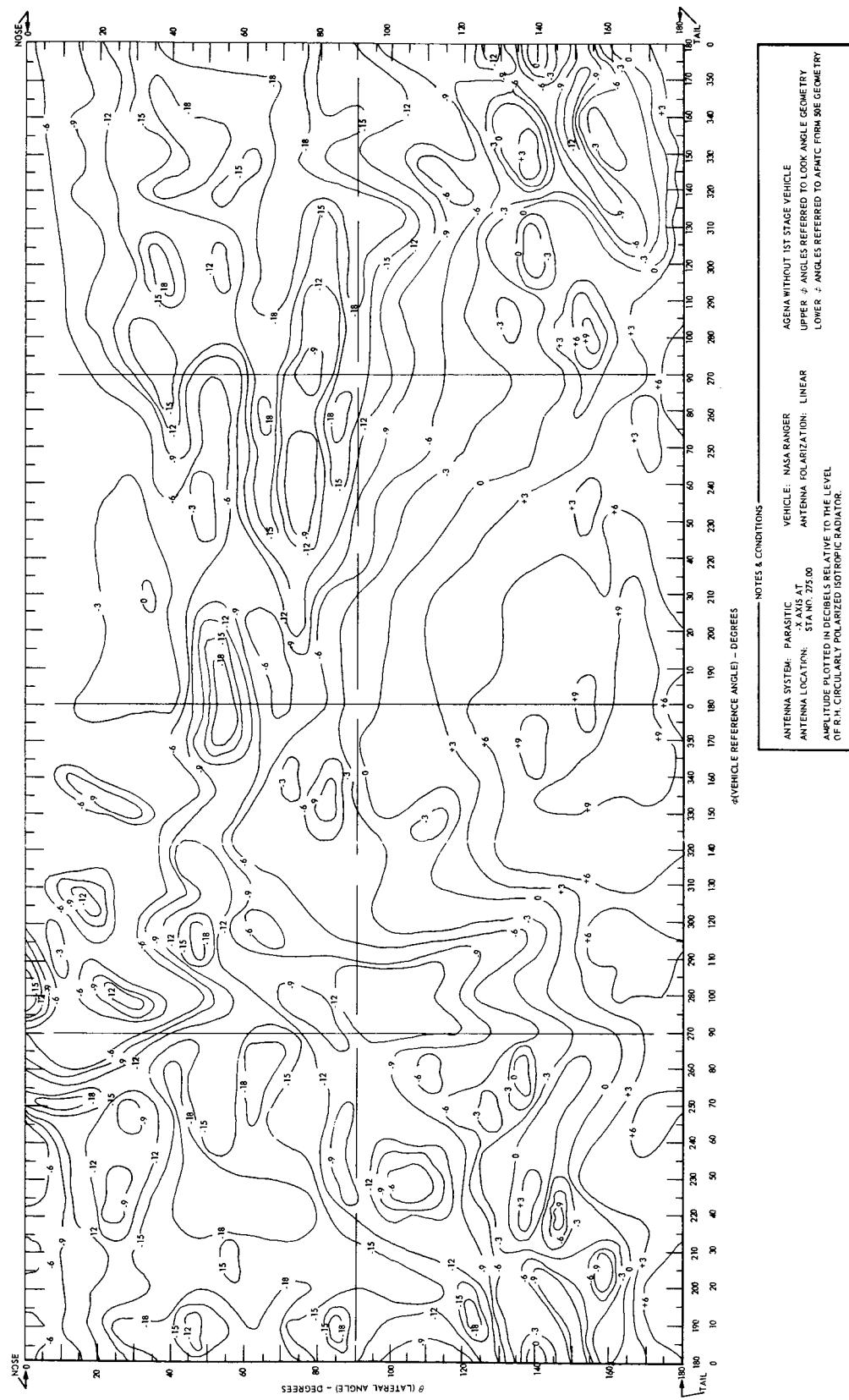


Figure 4-3 Parasitic Antenna Radiation Pattern - Agena Without 1st Stage Vehicle

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4.3 C-BAND BEACON ANTENNA SYSTEM

4.3.1 General Information

Antenna type: Recessed stub

Frequency range of operations (transponder):

Transmitter = 5555 Mc
Receiver = 5480 Mc

Coverage required: T + 0 sec to T + 1400 sec nominal.(Also, it is desired to track through T + 1926 sec to observe retromaneuver if possible.)

Frequency used for pattern: Measurements = 5550 Mc

Model scale: Full scale

4.3.2 Transmitter Information

Total power level at transmitter antenna system:

f = 5555 Mc Peak level = +53 dbm

The beacon is used with the AN/FPS-16 ground-radar equipment.

4.3.3 Receiver Information

Minimum power level required at receiver antenna system:

f = 5480 Mc (missile) level = -85 dbm at receiver input terminals

4.3.4 Polarization Information

Polarization Vectors:

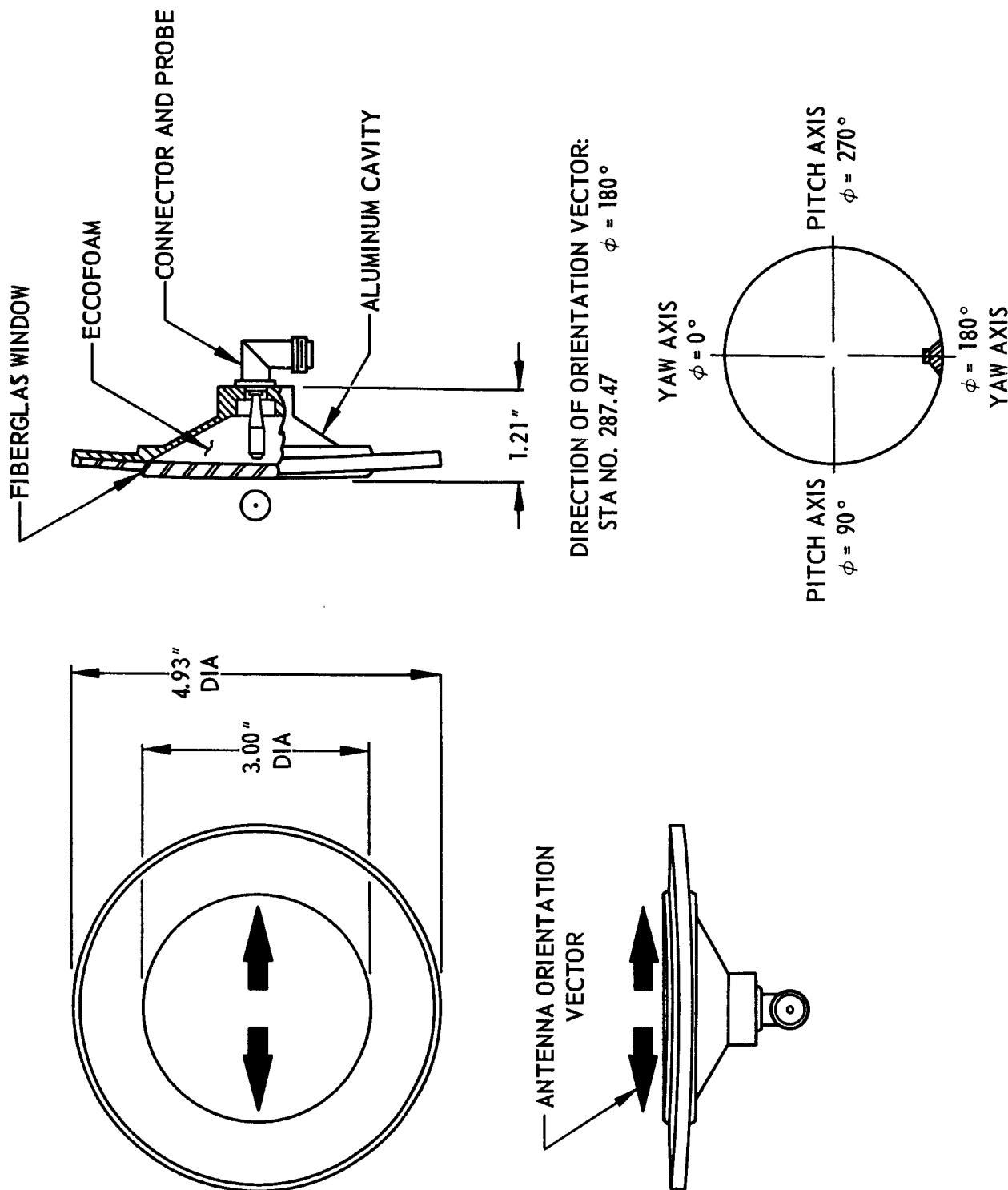
Linear - θ = LMSC Sta 287.47, ϕ = 180° (LMSC missile station location is given instead of angle θ because the c. g. is not known)

4.3.5 C-Band Beacon Antenna (Fig. 4-4)

This is a radiating stub recessed into a flush-mounted circularly symmetric cavity. The antenna provides a linearly polarized radiated power pattern

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(Figs. 4-5 and 4-6) similar to that of a quarter-wave monopole above a conducting ground with a polarization null directly on the axis of the antennas.

4.4 VHF TELEMETRY ANTENNA SYSTEM

4.4.1 General Information

Antenna type: Cavity backed "E" slot

Frequency range of operations:

Transmitter = 244.3 Mc

Receiver = 244.3 Mc

Coverage required: T + 0 sec to T + 1926 sec

Frequency used for pattern: Measurements = 970 Mc

Model scale: 1/4 scale

4.4.2 Transmitter Information

Total power level at transmitter antenna system:

f = 244.3 Mc Average level = +40 dbm (missile borne)

4.4.3 Polarization Information

Polarization Vectors:

Linear - θ = LMSC Sta 250.97, ϕ = 180° (LMSC station number is given instead of angle θ since the c. g. is not known)

4.4.4 VHF Exit Antenna (Fig. 4-7)

This antenna consists of an E-shaped slot printed on a dielectric window backed by a conducting cavity. The antenna provides a linearly polarized power pattern (Figs. 4-8 and 4-9) similar to that of a half-wave resonant circumferential slot on a cylinder. It has a diffraction pattern in the pitch plane which supplies an adequate signal from nose to tail for exit tracking; also, it has a single lobe pattern in the roll plane with a 3-db beamwidth of approximately 68°.

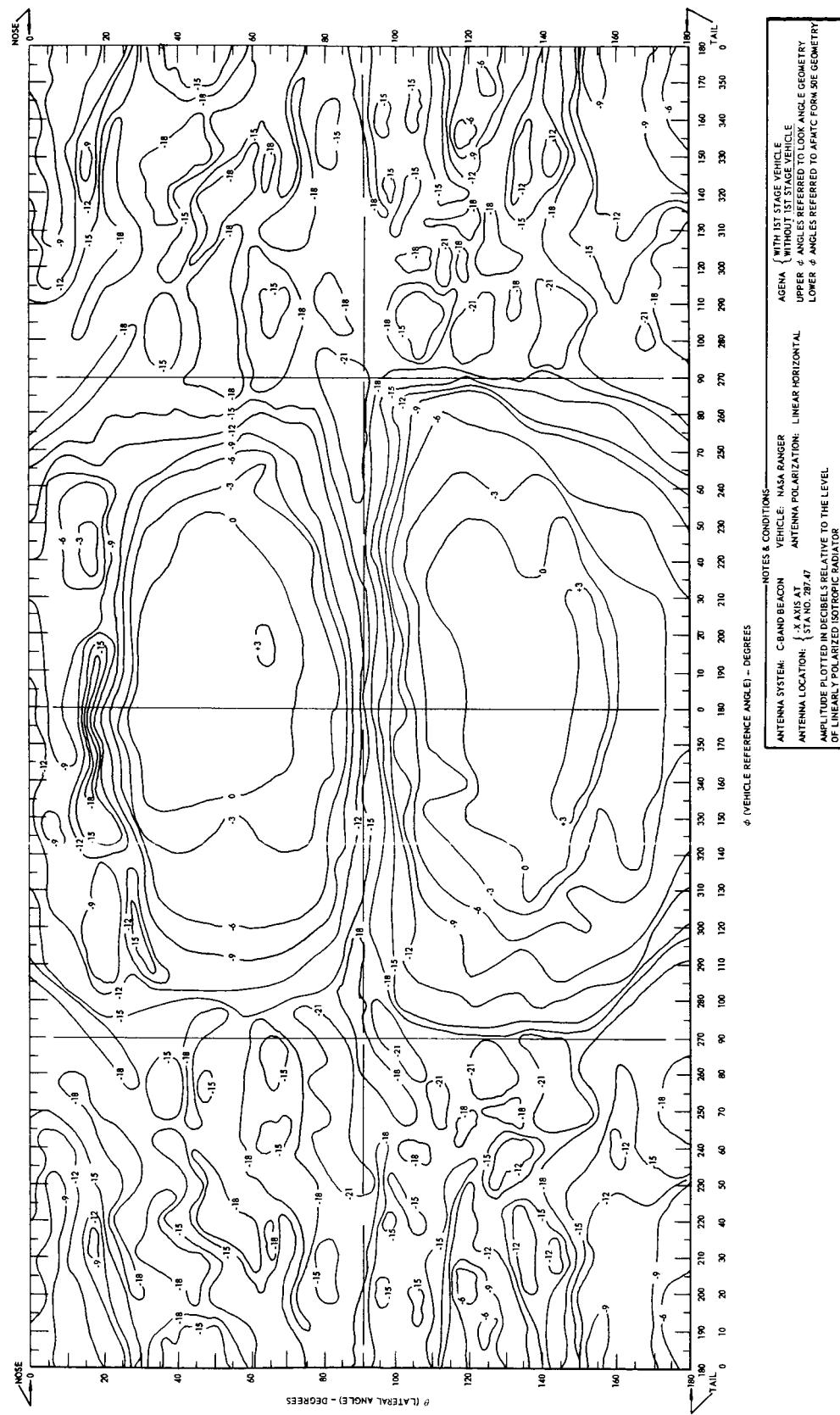


Figure 4-5 C-Band Beacon Antenna Radiation Pattern - Linear Horizontal Polarization

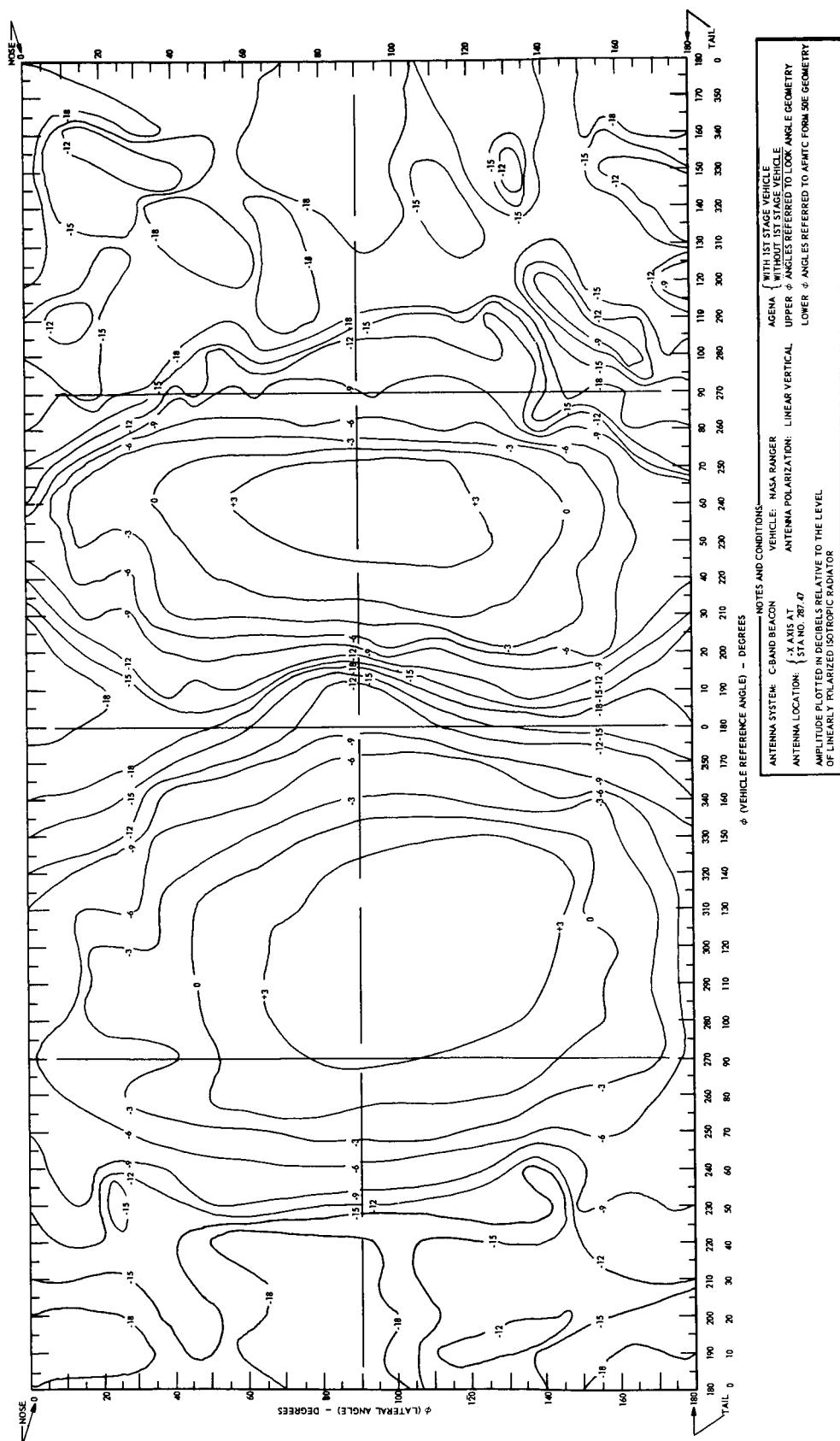


Figure 4-6 C-Band Beacon Antenna Radiation Pattern - Linear Vertical Polarization

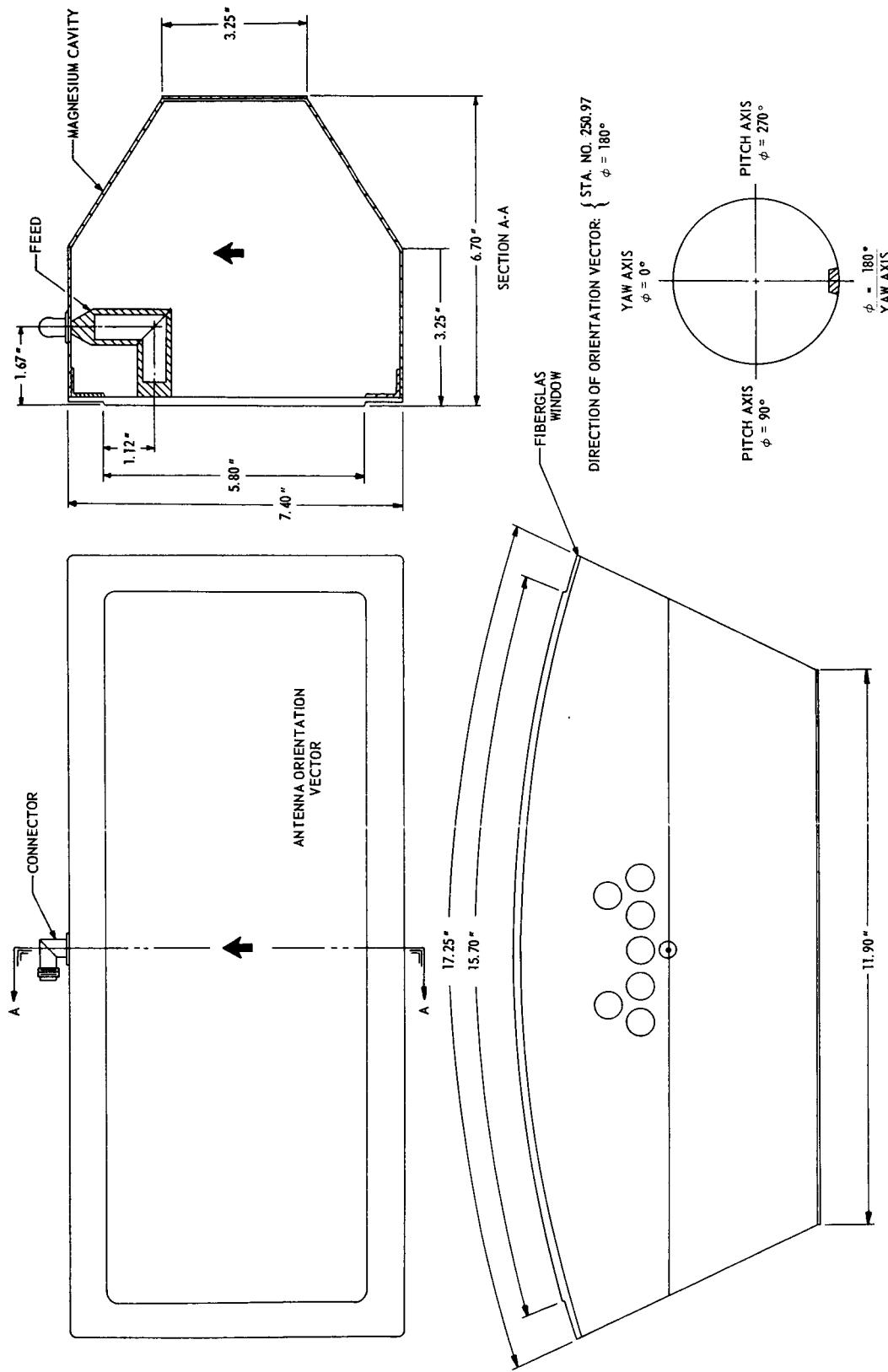
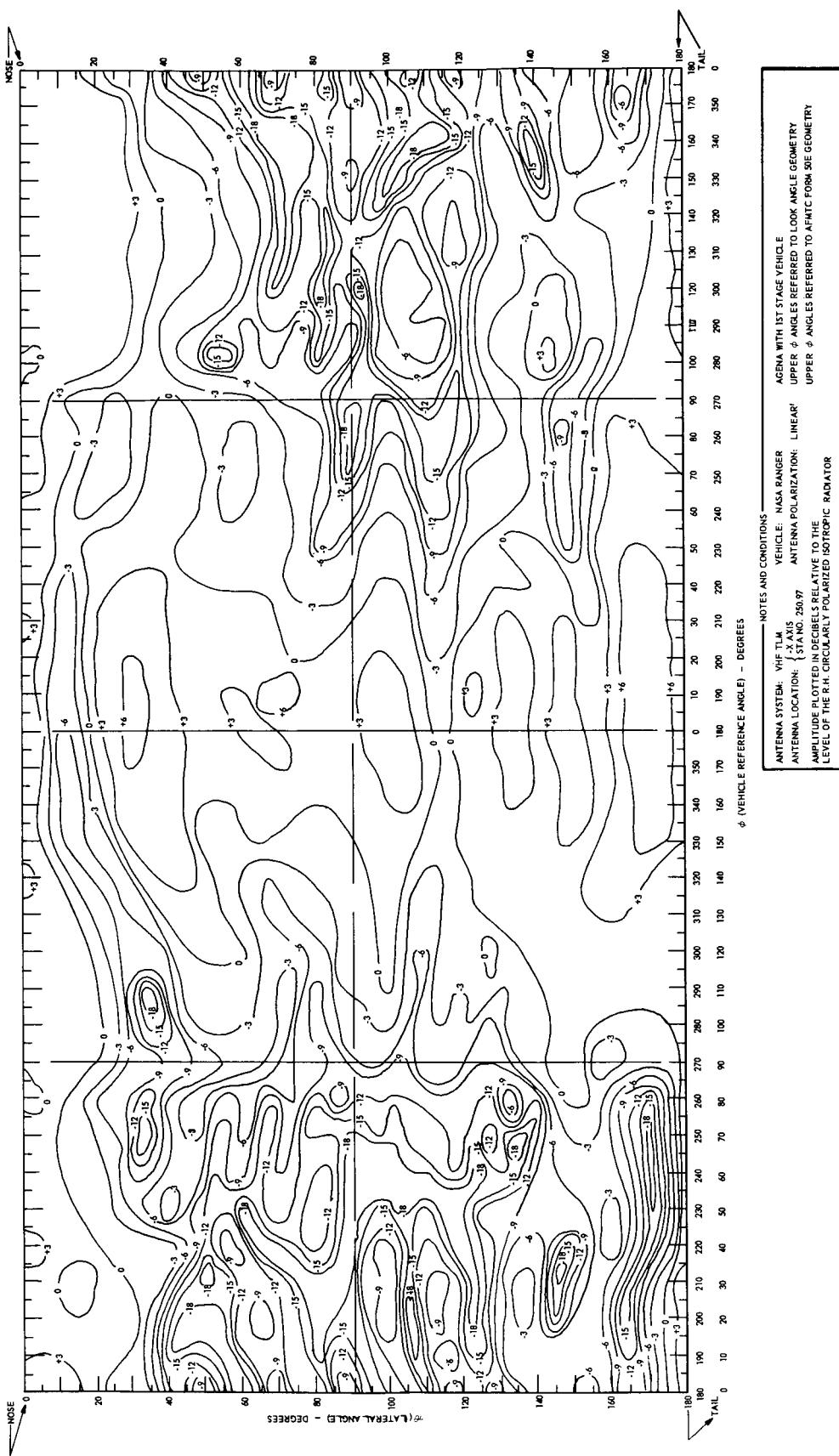
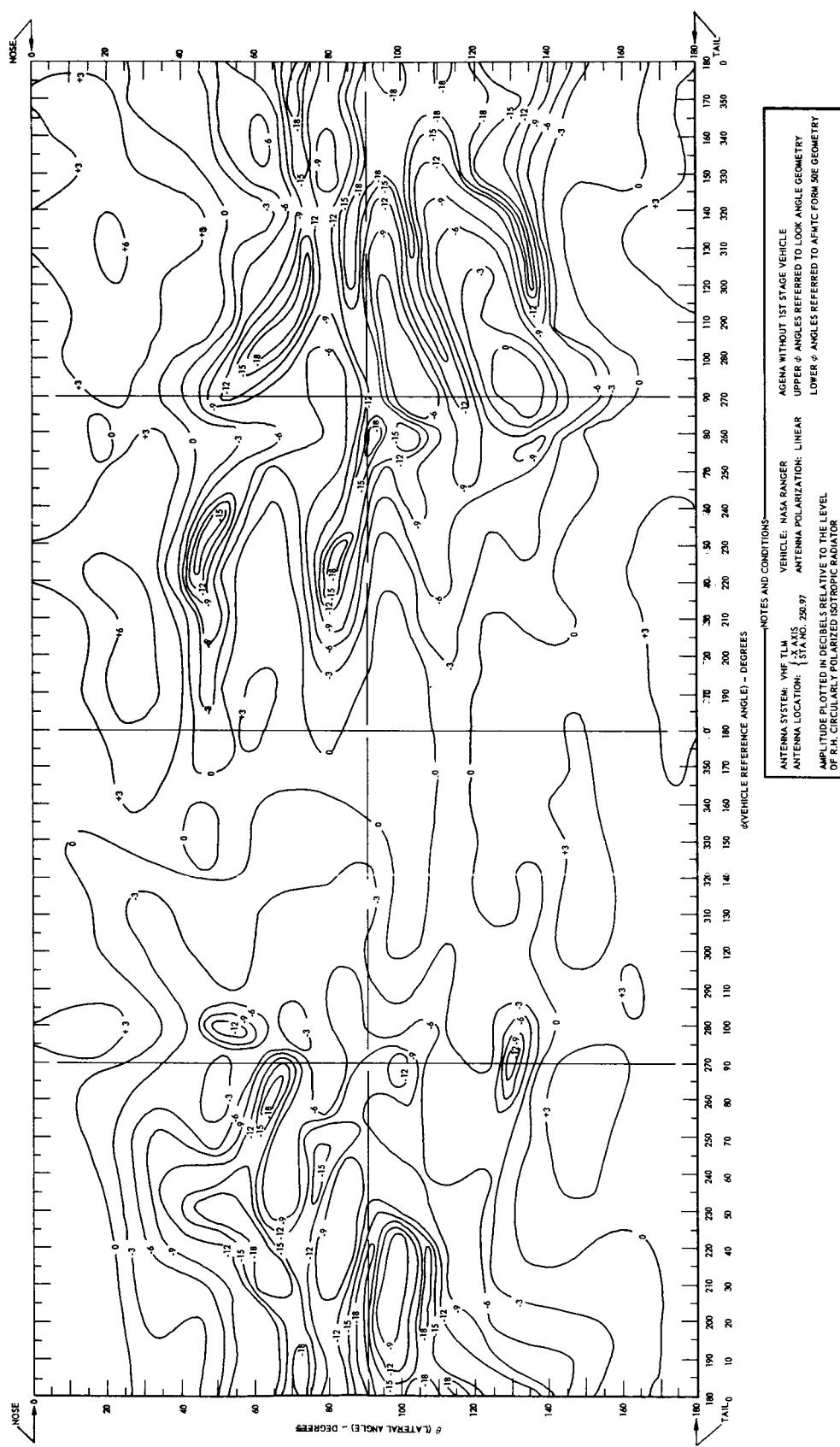


Figure 4-7 VHF Exit Telemetry Antenna



4-12

Figure 4-8 VHF Telemetry Antenna Radiation Pattern - Agena With 1st Stage Vehicle



4-13

Figure 4-9 VHF Telemetry Antenna Radiation Pattern - Agena Without 1st Stage Vehicle

APPENDIX
TELEMETER SYSTEM INSTRUMENTATION SCHEDULE

1. SCOPE

This specification describes the instrumentation requirements and minimum standard of performance for the telemeter system.

2. APPLICABLE DOCUMENTS

2.1 The following documents are to be considered as part of this specification to the extent indicated herein:

ATS 1072082 Telemeter system bench check
ATS 1072452 Unitized telemetry final vehicle checkout

2.2 This document supersedes all previously issued documents that specify requirements contained herein

2.3 The following documents are for reference only and are not to be considered a part of this specification:

Unitized FM/FM telemeter system - 1313690
System no. 9080
Wiring diagram unitized FM/FM telemeter system - 1313707
Schematic - 1313724

3. REQUIREMENTS

The telemeter instrumentation system shall conform to the requirements which are a part of this specification.

4. QUALITY ASSURANCE PROVISION

The telemeter subsystem shall conform to ATS 1072082

5. PREPARATION FOR DELIVERY

Not applicable.

6. NOTES

6.1 T/M system no. 9080
Transmitter dwg no. (ref.) 1600473-5

Frequency (Mc)	244.3
T/M dwg no. (ref.)	1313690
Mod amp	1321487-503

- 6.2 Transducers supplied by the telemetering system requiring action are coded as follows:
 - a. Transducers requiring installation in the vehicle or on a component are marked (X) on the sheets contained herein.
 - b. Transducers requiring out-of-plant installation in subsystems are marked (z).
- 6.3 Subsystems supply maximum voltage levels (20K maximum source impedance) as indicated in the XDCR range column. Voltage levels exceeding oscillator input range and requiring dividers in telemetry are marked "Y" in auxiliary equipment column.
- 6.4 Calibration curves conforming to data service department requirements shall be supplied for all measurements.

INSTRUMENTATION SCHEDULE (CONTINUOUS CHANNELS)

FLIGHT NO.	VEHICLE NO. 6001			TRANSMITTER NO.						
	RDB CHAN NO	FREQUENCY - CPS	TYPE	FUNCTION	MEAS NO	FREQ RESP (CPS)	MEASUREMENT RANGE	PICKUP	OSCILLATOR	REMARKS
1				JPL Base Band						
3				JPL Base Band						
4				JPL Base Band						
5				JPL Base Band						
6				JPL Base Band						
7				JPL Base Band						
8				JPL Base Band						
9										
*										
10				Payload Sep. Monitor #1 Accel. Radial	RA007 RA001	0-100 0-100	0-4" ±5g 0-4" ±5g	1613811-1 130155-537	232 232	
*				Payload Sep. Monitor #2 Accel. Radial	RA008 RA002	0-100 0-100	0-4" ±5g 0-4" ±5g	1613811-1 130155-537	232 232	
*				Payload Sep. Monitor #3 Accel. Lateral	RA009 RA003	0-100 0-100	0-4" ±5g 0-4" ±5g	1613811-1 130155-537	232 232	
12				Turbine Speed	B35	600	12000-35000 RPM	1320856	416	
*				Velocity Counter Output Accel. Output Digital	D88 D83	15 Bits at 60cps 350 PPS	SS/D SS/D	SS/D SS/D	258 248	
14				Comm. #1 Ring "A"		60 Points	5 rps			
15				Comm. #1 Ring "B"		60 Points	5 rps			
16				Vibration Axial	RA005	20 2Kc	±20 g	1308308-541	232	
17				Vibration Radial	RA006	20 2Kc	±20 g	1308308-541	232	
18										

* Dual purpose channels to be switched after second burn

** Dual purpose channel (SS/D) to provide switching

INSTRUMENTATION SCHEDULE

FLIGHT NO. _____ VEHICLE NO. 6001 COMMUTATED CHANNEL NO. 15
 TYPE COMMUTATOR 1062420-5 COMMUTATOR UNIT IA COMMUTATOR RATE 5 RPS

SEG.	FUNCTION	CODE	VOLT RANGE	TRANSDUCER		STATION
				TYPE	RANGE	
1	Cal 1/2					
2	Eng. Switch Group "A"	B113	0-5V		Step	417
3	Pitch Horizon Sensor	D41	0-5V	SS/D Volt	-5 to +5°	249
4	Eng. Switch Group "B"	B114	0-5V		Step	417
5	Yaw Hyd. Actuator Pos.	D69	0-5V	SS/D Volt	±4°	440
6	Comb. Chamber Press. #3	B91	0-5V	1600212-1	475 to 550 psig	433
7	Eng. Switch Group "F"	B120	0-5V		Step	417
8	Yaw Torque Rate	D65	0-5V	SS/D	0/20°/sec	261
9	Pitch Hyd. Actuator Pos.	D68	0-5V	SS/D Volt	±4°	440
10	Hyd. Oil Press.	D60	0-5V	1600279-1	0-4000 psig	412
11	Comb. Chamber Throat Surf. Temp.	B84	0-5V	1062939-1	32-600°F	423
12	Battery Case Temp.	C11	0-5V	1600293-6	-100 to +200°F	254
13	Roll Horizon Sensor	D42			SS/D Volt	249
14	400 cycle 1Ø Pwr. Amp.	C24	0-5V		112/117 Volts	263
15	Helium Supply Press.	B7	0-5V	1600279-1	0-4000 psig	443
16	Booster Pin Puller Mon. #1, 2 & 3	A26	0-5V	SS/A	Step	387
17	Repeat Pos. #2	B113				
18	Roll Torque Rate	D66	0-5V	SS/D	0-20°/sec	261
19	Repeat Pos. #4	B114				
20	Beacon Signal Level	H47	0-5V	SS/H Volt		267
21	Oxid. Tank Press.	B8	0-5V	4-380MAA-100 g-5K	0-100 psig	312
22	Repeat Pos. #7	B120				
23	Roll Pos. Gyro	D75	0-5V	SS/D Volt	±6°	261
24	Payload Pin Puller #1, 2 & 3	RA010	0-5V	SS/A Volt	Step	233
25	Fuel Tank Press.	B9	0-5V	4-380MAA-100 g-5K	0-100 psig	270
26	Beacon Pwr. Level	H48	0-5V	SS/H Volt		267
27	ZKC Inverter Temp.	C23	0-5V	1600293-6	-100 to +200°F	255
28	Ranger Shroud Sep. #1 & 2	RA012	0-5V	SS/A	Step	232
29	Cal +					
30	Ranger Shroud Sep. #3 & 4	RA013	0-5V	SS/A	Step	232
31	2nd Starter Can Surface Temp.	B85	0-5V	1062939-1	32-1000°F	422
32	Repeat Pos. #2	B113				
33	Pitch Pos. Gyro	D72	0-5V	SS/D	±6°	261

INSTRUMENTATION SCHEDULE

FLIGHT NO. _____ VEHICLE NO. 6001 COMMUTATED CHANNEL NO. 15
 TYPE COMMUTATOR 1062420-5 COMMUTATOR UNIT IA COMMUTATOR RATE 5 RPS

SEG.	FUNCTION	CODE	VOLT RANGE	TRANSDUCER		STATION
				TYPE	RANGE	
34	Repeat Pos. #4	B114				
35	Repeat Pos. #5	D69				
36	Repeat Pos. #6	B91				
37	Repeat Pos. #7	B120				
38	Ullage Rocket #2 & 4 (First Burn)	A177	0-5V	Switch SS/A	On-Off	445
39	Repeat Pos. #9	D68				
40	Repeat Pos. #10	D60				
41	Cal Zero					
42	Cal 1/2					
43	Yaw Pos. Gyro	D74	0-5V	SS/D Volt	$\pm 6^\circ$	261
44	Liner Temp. Sta. 225	RA016	0-5V	1062939-1	32-300°F	224
45	Ullage Rocket #1 & 3 (Second Burn)	A178	0-5V	Switch SS/A	On-Off	445
46	Inside Shroud Temp. Near Nose Sta. 106	RA014	0-5V	1062939-1	32-800°F	101
47	Repeat Pos. #2	B113				
48	Inside Shroud Temp. Near Base Sta. 208	BA015	0-5V	1062939-1	32-600°F	212
49	Repeat Pos. #4	B114				
50	Velocity Cut-Off Switch	D86	0-5V	SS/D Volt		258
51	Cal Zero					
52	Repeat Pos. #7	B120				
53	SS/D Timer Monitor	D34	0-5V	SS/D		264
54	Cal 1/2					
55	Horizon Sensor Fairing Temp.	A210	0-5V	1062939-1	32-1000°F	248
56	Pitch Torque Current	D73	0-5V	SS/D Volt	0-50 deg/min	261
57	Cal Zero					
58	Sync		5.25V			
59	Sync		5.25V			
60	Sync		5.25V			

INSTRUMENTATION SCHEDULE

FLIGHT NO. VEHICLE NO. 6001 COMMUTATED CHANNEL NO. 16
 TYPE COMMUTATOR 1062420-5 COMMUTATOR UNIT IB COMMUTATOR RATE 5 RPS

SEG.	FUNCTION	CODE	VOLT RANGE	TRANSDUCER		STATION
				TYPE	RANGE	
1	Combustion Cham. Press.	B6	0-5V	1308308-509	0-700 psig	432
2	Turb. Man. Press.	B3	0-5V	1600025-22	0-1000 psig	
3	Cal 1/2		2.5V			
4	Oxid. Venturi Inlet Press.	B11	0-5V	1600025-14	0-1200 psig	414
5	Oxid. Pump Inlet Press.	B2	0-5V	1600025-9	0-120 psig	409
6	#1 Gas Valve Press.	D91	0-5V	1600025-7	0-75 psig	445
7	Cal 1/2					
8	Repeat Pos. #1	B6				
9	Fuel Pump Inlet Press.	B1	0-5V	1600025-9	0-120 psig	412
10	28V Reg. Supply Voltage	C3	0-5V	SS/C Volt	+26 to +30v dc	260
11	Fuel Venturi Inlet Press.	B12	0-5V	1600025-14	0-1200 psig	417
12	Repeat Pos. #2					
13	Repeat Pos. #1	B6				
14	#2 Gas Valve Press.	D92	0-5V	1600025-7	0-75 psig	445
15	Liner Temp. Sta. 238.5	RA017	0-5V	1062939-1	32-500°F	239
16	#3 Gas Valve Press.	D93	0-5V	1600025-7	0-75 psig	445
17	Cal 1/2					
18	#4 Gas Valve Press.	D94	0-5V	1600025-7	0-75 psig	445
19	Repeat Pos. #1	B6				
20	Atlas/Agena Sep. Mon. Staircase	A93	0-5V		Step	453
21	#5 Gas Valve Press.	D95	0-5V	1600025-7	0-75 psig	445
22	Repeat Pos. #2					
23	#6 Gas Valve Press.	D96	0-5V	1600025-7	0-75 psig	445
24	Control Gas Supply Press.	D59	0-5V	1600279-1	0-4000 psig	448
25	Repeat Pos. #1	B6				
26	Control Gas Reg. Press.	D58	0-5V	1600025-11	0-200 psig	448
27	Cal 1/2					
28	Cal +		5.0V			
29	Booster Command Monitor	D37	0-5V	SS/D Volt		264
30	400 cycle Pwr. Supply BCØ	C32	0-5V	SS/C	112 to 117v ac	256
31	Repeat Pos. #1	B6				
32	Repeat Pos. #2					
33	2 Kc Pwr. Supply	C8	0-5V	SS/C Volt	110 to 120v ac	256
34	Repeat Pos. #4	B11				
35	Repeat Pos. #5	B2				

INSTRUMENTATION SCHEDULE

FLIGHT NO. _____ VEHICLE NO. 6001 COMMUTATED CHANNEL NO. 16
 TYPE COMMUTATOR 1062420-5 COMMUTATOR UNIT IB COMMUTATOR RATE 5 RPS

SEG.	FUNCTION	CODE	VOLT RANGE	TRANSDUCER		STATION
				TYPE	RANGE	
36	Adapter Temp. Sta. 238.5	RA018	0-5V	1062939-1	32-500°F	239
37	Cal 1/2					
38	Repeat Pos. #1	B6				
39	Repeat Pos. #9	B1				
40	400 Cycle Pwr. Supply ABØ	C31	0-5V	SS/C Volt	112 to 117v ac	256
41	Repeat Pos. #11	B12				
42	Repeat Pos. #2					
43	Repeat Pos. #1	B6				
44	Control Gas Supply Temp.	D70	0-5V	1600293-6	-50 to +150°F	445
45	Oxid. Valve N2 Closing/Press.	B110	0-5V	1600025-15	0-2000 psig	444
46	Oxid. Pump Inlet Temp.	B32	0-5V	Thermistor 1062960-1	30-80°F	
47	Cal 1/2					
48	Battery Bus Volts (+)	C1	0-5V	SS/C	22 to 30v dc	254
49	Repeat Pos. #1	B6				
50	Fuel Pump Inlet Temp.	B31	0-5V	Thermistor 1062960-1	30-80°F	
51	Repeat Pos. #20	A93				
52	Repeat Pos. #2					
53	Adapter Temp. Sta. 238.5	RA019	0-5V	1062939-1	32-500°F	239
54	Reg. Supply Volts (-)	C5	0-5V	SS/C	-26 to -30v dc	265
55	Repeat Pos. #1	B6				
56	Cal Z		0.0V			
57	Cal 1/2					
58	Sync		5.25V			
59	Sync		5.25V			
60	Sync		5.25V			

ENGINE SWITCH GROUP FUNCTIONS

SWITCH GROUP "A" (B113)

B21 Thrust Chamber Pressure Switch
B111 Gas Generator Igniter #2
B20 Fuel Valve Pilot Valve

SWITCH GROUP "B" (B114)

B22 Shut Down Relay
B112 Engine Power Supply (28V)
B19 Oxidizer Manifold Pressure

SWITCH GROUP "F"

B16 Gas Generator Igniter #1
B15 Main Power Relay

DISTRIBUTION

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